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Experience of Implementing WiMAX Test Cases Using TTCN-3

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Overview

- WiMAX Forum & ETSI BRAN
- HiperMAN/WiMAX testing project
- Abstract Test Specification Document
- TTCN-3 Code Development
- Conclusions

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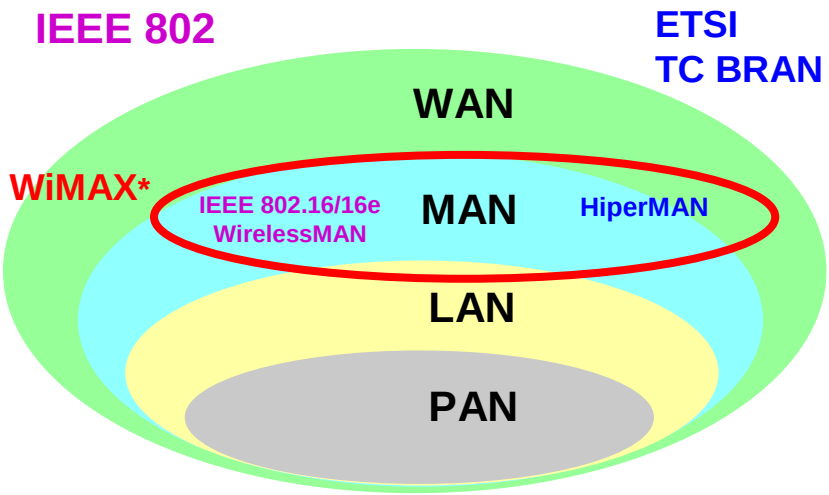
Global Wireless Standards



* Industry fora for promotion & certification

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WiMAX Forum & ETSI TC BRAN

- WiMAX Forum
  - Supports and promotes deployment of IEEE802.16/HiperMAN type of systems
  - Set up the certification scheme to assure interoperability of WiMAX compliant devices
  - Controls all aspects of the certification
- ETSI Technical Committee BRAN
  - Development and maintenance of HiperMAN DLC and PHY specifications, harmonization with IEEE802.16
  - Development of HiperMAN/WiMAX test specifications that are being used in the WiMAX certification scheme
  - Has proven expertise in testing matters
  - Has proven track record of working with industry

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HiperMAN/WiMAX testing project

- The ETSI PTCC was chosen by BRAN and the WiMAX Forum to develop, validate and continuously maintain HiperMAN/WiMAX test suites.
- The project was started by ETSI BRAN in 2003/2004 with 20 man month resource
- The project continued jointly with WiMAX with 55 man month spent in 2005 and 2006.
- Further 40 man months is used in 2007, 47 man months are planned for 2008
- In addition, 12 man months of voluntary resource will have been used until the end of 2007
- Eight part time experts are currently working in the team led and managed by ETSI CTI (Centre for Testing & Interoperability)

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The team

- Alain-Georges Vouffo Feudjio
- Alexandre Berge (recent addition)
- Chieh-Ying Kan
- Finn Kristoffersen
- Francois Fischer
- Jean-Claude Wattelet
- Miguel Angel Reina Ortega
- Sebastian Mueller
- Milan Zoric (Project leader)

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Validation activities

Project Team (STF 252)

- Initial test case development
- Analysis of testing error reports
- Rewriting of test cases
- Maintenance of the test suite
- Test spec version management
- Intermediate test code delivery
- Compilation of regression results
- Final test spec deliveries

ETSI BRAN HiperMAN /WiMAX Forum

- Approve test specifications
- Approve change requests for the above
- WiMAX Forum alone will decide on the use of test cases in certification

Test Tool Vendors

- Compilation of test code
- Integration into test platforms
- Implementation of external functions
- Running of test cases during validation (several IUTs)
- Preparation of error reports
- Running of regression tests

Validation engineers

- running of test cases including regression test runs
- traces and their analysis
- error reports
- validation that test cases achieve the test purposes
- validation of test documentation

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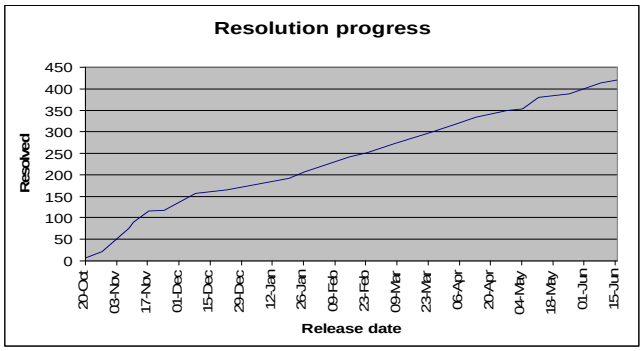
Change requests handling



- 421 reported issue resolved (June 2007)
- Most issues waiting for STF252 action get resolved within a week
- Issues requiring resolution between PCT vendors and STF252 tend to be harder and take more time

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Resolution statistics

Summary

By Status	Open	Resolved	Closed	Total
feedback	8	-	-	8
acknowledged	1	-	-	1
assigned	20	-	-	20
resolved	-	568	-	568
closed	-	-	15	15

Time Stats For Resolved Issues (days)

Longest open issue	577
Longest open	132.05
Average time	8.65
Total time	5,042.56

Issue History

Date Modified	Username	Field	Change
01-26-07 07:35	tom_aeroflex	New Issue	
06/07/2007 09:46	Milan	Resolution	open => fixed

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Achievements

- HiperMAN1.2.1/IEEE802.16-2004 test specifications
  - have been validated and WiMAX certification laboratory has started wave 2 testing with ~300 test cases.
  - In the process, updated versions of all HiperMAN1.2.1/WiMAX test specification documents have been approved and will be published shortly.
- HiperMAN1.3.1/IEEE802.16e-2005 test specifications
  - The major achievement is the finalization of the first stable and complete version of the TSS&TP document.
  - TTCN-3 work in progress
    - Development of additional test cases
    - Integration and validation efforts of delivered test cases
  - 230 test cases in TTCN-3 have been delivered to test equipment vendors
  - The work is progressing and first 30+ test cases have been validated and we expect significant acceleration in the coming days rather than weeks.

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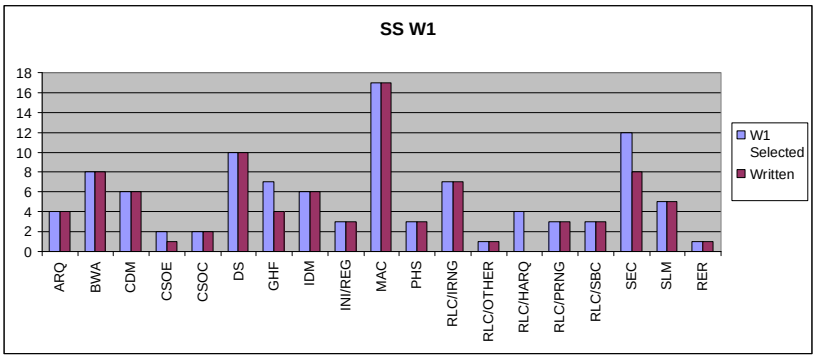
Delivered Test Cases



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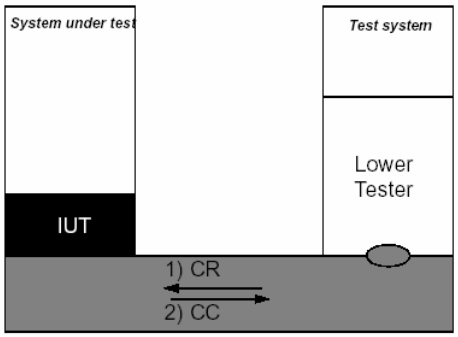
Abstract Test Specification Document

- **Is developed according to the ISO 9646 methodology**
- **In principle most interesting for companies that are developing protocol testing platforms for WiMAX systems**
- **It defines how parts developed by ETSI and parts developed by test equipment vendors communicate and interact**
- **Important parts**
  - **Test method**
  - **Test Architecture**
  - **PIXIT documentation**
  - **External function documentation**
  - **Naming conventions**

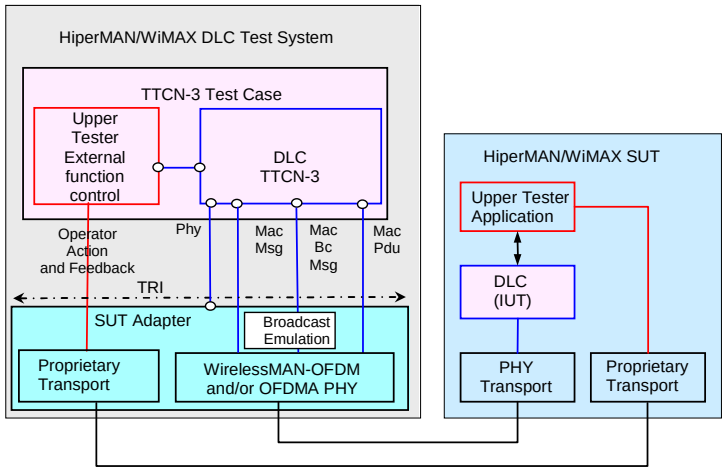
Remote Test Method (R)



1) LT sends the PDU CR to IUT.
Something happen so that the IUT sends CC to LT
2) LT receives CC

- No Upper Tester
- Manual coordination
- Limited, but easy to use

Single DLC BS/SS Test Configuration



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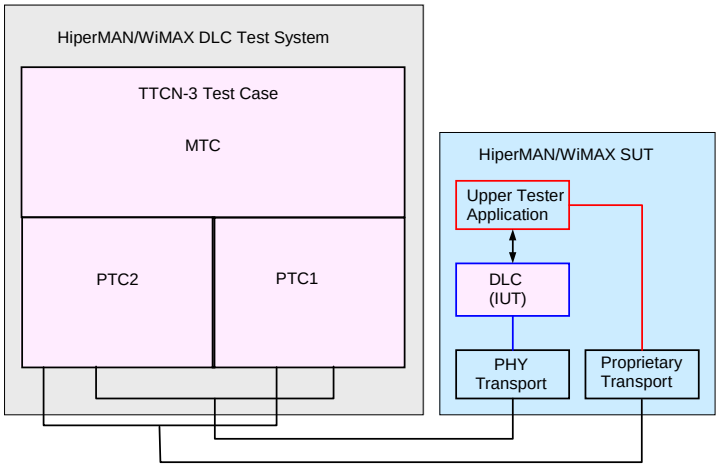
Concurrent DLC BS/SS Test Configuration



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Ports and their associated primitives

- one MacMsg type port
  - This port is used to send and receive MAC management messages.
  - MAC management messages could be fragmented or MAC PDU could contain several MAC management messages (Packed).
  - As it is difficult to specify defragmentation or unpacking procedures in TTCN, it was decided to create a dedicated port to exchange complete MAC management messages, extracted from the MAC PDU(s) and re-constructed as necessary.
  - In addition to the MAC messages, several other information shall be transmitted in the MsgInd primitive:
- one MacBcMsg type port
- one MacPdu type port
- one Phy type port

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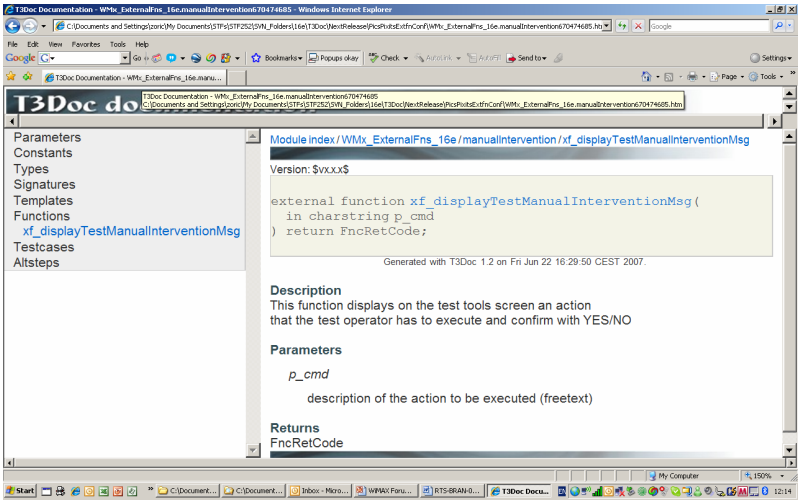
T3Doc external function documentation



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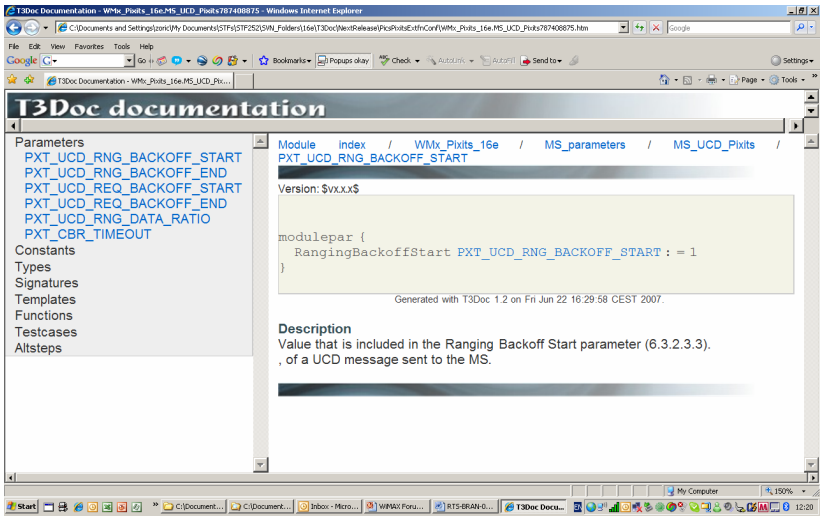
T3Doc PIXIT documentation



Naming conventions

- ATS document specifies in detail the naming guidelines for each element of the TTCN-3 language indicating the recommended prefix, suffixes (if any) and capitalization.
- The guidelines specify:
  - in most cases, identifiers should be prefixed with a short alphabetic string (specified in table 10) indicating the type of TTCN-3 element it represents;
  - suffixes should not be used except in those specific cases identified in table 7;
  - prefixes and suffixes should be separated from the body of the identifier with an underscore ("_"):
  - EXAMPLES: c_sixteen, t_wait_max.
  - Only module names, data type names and module parameters should begin with an upper-case letter. All other names (i.e. the part of the identifier following the prefix) should begin with a lower-case letter:
  - The start of second and subsequent words in an identifier should be indicated by capitalizing the first character. Underscores should not be used for this purpose:
  - EXAMPLE: f_authenticateUser.
- The naming conventions are used
- Found to be essential for the cooperative environment (ETSI, Test Equipment vendors, validation engineers)

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TTCN-3 Code Development

- Test purposes for HiperMAN/WiMAX systems are not detailed
  - They express what needs to be tested in terms of the requirement in the standard
  - They do not define the details
- For this reason, it was decided that, as first step in development and part of test case documentation, the test strategy for test case each test case will be developed
- Example on the next slide

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Using Test Strategy as Design Document

TP ID: TP/BS/CDM/MFS/OPN/BV-005

- Reference: §6.3.2.3.4,§6.3.2.3.3
- PICS item: PIC_MOB1
- Initial Condition: IUT is operating.
- Expected Behavior: Check that: The IUT includes an Uplink Burst Profile in the UCD for each UIUC used in the UL-MAP message.
- Test strategy:
  - Receive Broadcast Message and Analyze the received UCD and UL-MAP by calling external functions:
    1. Receive Broadcast Message: (Ref. xf_ssSimuRecordReceivedUcdUlMap)
    2. Start recording the received UCDs and UL-MAPs among the broadcast messages. The receiving queue is filtered. Only UCD and UL-MAP messages are remained in the receiving queue.
       - Count the UCD having received.
       - Upon the Test Adapter receiving the sixth UCD, the external function returns successfully with the function return code equalling e_success.
    3. Analyze the received UCD and UL-MAP:
       - Collect UIUCs from the UL-MAP_IE.
       - Check that there shall not have any duplicated UIUCs.
       - Check that for each UIUC field in the UL-MAP_IE has a corresponding Uplink Burst Profile field in the UCD.

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Generic Functions

- The following principles have been used in structuring the code
  - Main test case body is always well separated from preambles
  - Test case in principle uses only the features required
    - When testing packing, the feature is enabled and used, otherwise not
  - Preambles are functions with parameters that enable easy selection of required features
- For example, function f_iniUlSrvFlow (in template UplinkDsaServiceFlowTLVs p_uplinkDsaServiceFlowTLVs, out UInt8 p_index)
  - Many different connections can be established by passing appropriate parameters
    - ParameterSets to specify an option of QoS type
    - RequestTransmissionPolicy to specify an option of transmission policy

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Conclusions

- HiperMAN/WiMAX test suite is one of the biggest test suites using TTCN-3 at this point in time
- The work started when
  - Experience with TTCN-3 was not very big
  - Tool support was there but with instabilities
- At the start, relations between partners had to be defined (ETSI BRAN, WiMAX technical groups, test equipment vendors, validation engineers)
- Achievements are there with more to come soon
- Experience in terms of TTCN-3 shows that:
  - TTCN-3 is very suitable for this kind of development
  - Coding practices, general and project specific are extremely important